General

Guideline Title

ACR Appropriateness Criteria® acute hip pain—suspected fracture.

Bibliographic Source(s)

Ward RJ, Weissman BN, Kransdorf MJ, Adler R, Appel M, Bancroft LW, Bernard SA, Bruno MA, Fries IB, Morrison WB, Mosher TJ, Roberts CC, Scharf SC, Tuite MJ, Zoga AC, Expert Panel on Musculoskeletal Imaging. ACR Appropriateness CriteriaÂ® acute hip pain--suspected fracture. [online publication]. Reston (VA): American College of Radiology (ACR); 2013. 8 p. [48 references]

Guideline Status

This is the current release of the guideline.

Recommendations

Major Recommendations

ACR Appropriateness Criteria®

Clinical Condition: Acute Hip Pain—Suspected Fracture

Variant 1: Middle-aged and elderly patients. First study.

Radiologic Procedure	Rating	Comments	RRL*
X-ray hip	9	AP and cross-table lateral views should be performed. Perform x-rays of both hip and pelvis.	
X-ray pelvis	9	AP view should be performed. Perform x-rays of both hip and pelvis.	
MRI pelvis and affected hip without contrast	1		O
MRI pelvis and affected hip without and with contrast	1		O
CT pelvis and hips without contrast	4		
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative

Radiologic Procedure	Rating	Comments	RRL*
CT pelvis and hips with contrast	1		
CT pelvis and hips without and with contrast	1		
US hip	1		O
Tc-99m bone scan hip	1		
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Middle-aged and elderly patients. Negative or indeterminate radiographs.

Radiologic Procedure	Rating	Comments	RRL*
MRI pelvis and affected hip without contrast	9		O
CT pelvis and hips without contrast	6		
MRI pelvis and affected hip without and with contrast	4	See statement regarding contrast in text under "Anticipated Exceptions."	O
Tc-99m bone scan hip	4	Consider using SPECT or SPECT/CT.	
CT pelvis and hips with contrast	1		
CT pelvis and hips without and with contrast	1		
US hip	1		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

Introduction/Background

The impact of hip fracture or, more accurately, proximal femoral fracture on society, is considerable from both a health and economic perspective. Recent studies have shown an incidence of hip fracture in approximately 957 per 100,000 women in the United States, with an approximate 30% mortality rate within the first year after the fracture. Although data appear to demonstrate a recent decline in the fracture rate and subsequent mortality corresponding with the rise of bisphosphonate treatment, osteoporosis and proximal femoral fragility fracture remain a substantial cause of death in the United States. The mortality rate from fragility fractures is approximately twice that of breast cancer. The economic impact of proximal femoral fracture has been estimated at $40,000/patient. Costs are considerably higher in cases that go initially undiagnosed. Estimates of undiagnosed fractures have ranged from 3% to 9% depending on the age group. An approach to diagnosis founded on available evidence is our best option for minimizing the substantial morbidity and mortality associated with missed proximal femoral fractures.

Radiography

Radiography is the established initial imaging study of choice for assessing the acutely painful hip. Radiographs of the hip are widely available, logistically simple for the patient, technically straightforward for the technologist, and relatively inexpensive. As with any trauma-related musculoskeletal radiographic studies, orthogonal views are considered standard. Hip anteroposterior (AP) and cross-table lateral views satisfy this requisite. An AP view is taken with the leg in approximately 15° of internal rotation. However, because nonresponsive, high-energy trauma patients often present in external rotation, a Judet view with 40° of angulation of the pelvis is suggested. The Judet or 40° contralateral posterior oblique view will separate the superimposed head and greater trochanter for adequate evaluation. Another strategy for obtaining orthogonal views of the proximal femur is the frog-leg lateral, a position that puts the patient in maximal abduction by placing the soles of the feet together. However, the literature recommends against this view in cases of suspected proximal femoral fracture or dislocation, as it may further displace the fracture and complicate the injury.

The initial imaging study for acute hip pain in low-energy trauma is the radiograph. However, radiographs have been shown to have limited sensitivity. In one series, magnetic resonance imaging (MRI) revealed fractures in 37% of patients who had negative radiographs for proximal femur fracture. A more recent study demonstrated false-negative and -positive radiographic findings, which led the authors to conclude their study demonstrated "poor sensitivity and specificity of radiography of the proximal femur and pelvis in emergency department evaluation of patients with pain or suspected trauma around these structures." In a recently published 10-year retrospective study, MRI showed fractures in 83 of 98 patients with negative radiographs. Ultimately, radiographs alone cannot exclude fracture in older patients. There is no current data on the sensitivity and specificity of radiography in the younger patient population; therefore, clinicians are suggested to proceed with caution.

Computed Tomography

Computed tomography (CT) is widely available, rapid, and easily tolerated by patients with potential hip injuries. The literature cites the use of CT for hip fracture since 1980. CT was found to be useful in evaluating the presence of intra-articular, loose osseous fragments within joints. Later, the focus shifted to hip injury and evaluation of acetabular fractures. Numerous studies using MRI as the gold standard cite CT's improved sensitivity to fracture when compared to radiographs. One study demonstrated that CT had a femoral neck fracture sensitivity of 70%; however, sensitivity decreased to 58% when femoral head fracture subjects were included. A recent review proposed an algorithm that used CT following negative radiographs in cases of high-energy trauma. The rationale was that the substantial forces experienced in high-energy trauma would likely cause cortical disruption that could be well-demonstrated with CT. However, the authors did not mention the likely concurrent abdominal and pelvic CT imaging from which the high-energy trauma patient's proximal femora could be evaluated. Currently, there are no data to suggest that CT alone could rule out fracture in high-energy trauma among the younger age group; however, such an approach appears sensible. Alternatively, younger high-energy trauma patients who do not undergo scanning for other potential injuries would likely benefit from the more sensitive MRI examination to avoid the substantial radiation associated with pelvic and hip imaging.

A more recent, retrospective study of CT demonstrated impressive findings. Among 193 patients who underwent CT, 84 scans were negative for fractures. Subsequent MRI or other diagnostic criteria found 4 of those 84 to have fractures. These results indicate a CT sensitivity of 95%. The authors described interpretation criteria from a previous study and admitted that using CT to identify fracture "may sometimes be more difficult to interpret than MRI, especially for inexperienced radiologists." The major weakness of this study was the absence of an imaging gold standard for all cases. Using the same technique, the authors had demonstrated near perfect interobserver agreement with kappa values ranging from 0.85 to 0.97. Further application of these advanced interpretation strategies within the community setting may help guide future recommendations.

Magnetic Resonance Imaging

Since 1989, the literature has shown the use of MRI in identifying radiographically occult proximal femoral fracture. All 23 patients scanned by one group of researchers were later determined to have fractures, as demonstrated by MRI. In another study using clinical outcomes as a standard, MRI demonstrated 100% accuracy in detecting fractures in 20 patients who had indeterminate radiographs. An early study comparing MRI with scintigraphy for evaluating occult fractures demonstrated comparable sensitivity. In an additional study, MRI detected fractures in 10 of 15 patients who had negative radiographs for femoral fracture. The remaining 5 patients were evaluated as negative on MRI and successfully treated conservatively. In yet another confirmatory study of 33 patients, MRI found fractures among two-thirds; the patients with negative MRIs were followed over time to confirm that they did not subsequently fracture. These studies suggest that MRI for radio-occult proximal femur fracture is highly sensitive, specific, and accurate in evaluating fracture.

In addition to increased sensitivity in proximal femoral fracture detection, MRI has been shown to be useful in characterizing fracture morphology. One reported study described MRI's ability to unequivocally detect the incomplete intertrochanteric fracture in 31 patients. Although complete fractures require surgery, incomplete fractures potentially may be treated conservatively. The clinical significance of distinguishing incomplete versus complete intertrochanteric fractures was demonstrated in a study that followed 68 patients with suspected fracture of the proximal femur. Eight patients were identified with incomplete intertrochanteric fractures; 3 were treated operatively, and 5 were treated conservatively. None were admitted for completion of their fracture. The study suggests that patients with incomplete intertrochanteric fractures may be treated conservatively and, consequently, that MRI may have a future role in directing treatment.

Additionally, authors have evaluated MRI's ability to detect extra-femoral trauma in cases of acute hip pain and negative radiographs. A study to evaluate the frequency of unsuspected pelvic fracture in patients sent for MRI to evaluate for proximal femoral fracture demonstrated that 80% of patients had significant pelvic bone or soft-tissue abnormalities. Of those patients whose scans were negative for proximal femoral fracture, 50% were found to have bone or soft-tissue abnormalities. A more recent study in patients without radiograph evidence of proximal femoral fracture found that 14 of 28 patients had fractured femurs. Of those patients who were radiographically negative for proximal femur fracture, all had alternative causes for symptoms, including gluteus maximus strains, hematomas, avascular necrosis, or effusions. In a larger series of 70 patients worked up for proximal femur fracture, 21% had pubic rami fractures, and 19% had sacral fractures. In this study, it was interesting that patients with proximal femur fractures had lengths of stay twice (21 days) those of patients with insufficiency pelvic fractures and soft-tissue injuries (10–11 days), suggesting that ruling out proximal femur fractures may allow for more rapid transfer to rehabilitation and a potential savings of acute care resources.

Multiple studies have confirmed that MRI sensitivity approaches 100% in cases of occult hip fractures. It is important to determine whether using MRI to evaluate such cases is cost effective and, if so, which patient population may best benefit from it. Several studies have examined the cost-effectiveness of MRI in occult fracture detection. One study demonstrated that delaying surgery only 1 day led to 1.27 times greater risk of death. A second study challenged the assertion that increased preoperative time was associated with increased mortality when corrected for comorbidities. However, there was an increased length of stay in the delayed group, again emphasizing the cost-effectiveness of an early and accurate diagnosis with respect to proximal femur fracture. A third study supported the finding that a delay in surgery in patients corrected for comorbidities led to increased mortality. A subsequent study confirmed the increased mortality and morbidity with delayed diagnoses. Finally, a meta-analysis has demonstrated that early surgery leads to decreased length of stay, morbidly, and mortality.

A 1998 study measuring the cost-effectiveness of MRI against bone scintigraphy emphasized that the time to diagnosis using a bone scan was roughly 4 times greater than with MRI. The time to surgery in the bone scan group was 1 day greater than for the MRI group. More recently, a group in Denmark evaluated the cost-effectiveness of MRI and demonstrated high sensitivity, specificity, and accuracy with excellent agreement between radiology readers as well as a savings of approximately €250–650 ($325–845 US) related to prompt diagnosis. Another group of researchers demonstrated the overall cost-effectiveness in allocating additional health-care resources for performing surgery <48 hours after patients were diagnosed with proximal femur fractures.

Specific scanning protocols have emphasized either speed or comprehensiveness. In 1993, researchers suggested a single T1-weighted sequence to evaluate for fracture. With equipment from 1993, the 7-minute sequence proved 100% accurate in detecting hip fractures. A more recent study suggested the usefulness of limited imaging for a rapid, more cost-effective, definitive diagnosis. The use of contrast has been suggested as a way to potentially change femoral neck fracture treatment algorithms based on vascularity of the femoral head. In a study from Japan, dynamic contrast-enhancement curves were predictors of avascular necrosis, potentially guiding treatment between screw fixation and arthroplasty. The study results suggested that nondisplaced fractures demonstrated normal head vascularity and displaced fractures had abnormal vascularity. These results support the utility of the present radiographic Garden classification. Alternatively, nondisplaced fractures showed decreased perfusion in a study from Japan that demonstrated decreased enhancement perfusion curves in 4 of 16 patients who had nondisplaced intra-articular fractures, with 2 cases progressing to avascular necrosis. A more recent study demonstrated decreased vascularity in only 1 of 17 (6%) of the nondisplaced fractures. Given the relatively small number of cases with vascular compromise at this time it is not clear that contrast-enhanced MRI of the hip is useful in evaluating nondisplaced hip fracture.

With emphasis on time to diagnosis, some emergency departments have adopted a CT strategy for evaluating radiographically occult fracture. Because a CT scan is fast and readily available, a noncontrast scan of the hip is a tempting option for a quick and seemingly sensitive modality when a proximal femoral fracture is suspected in a patient with fracture-negative radiograph.

Head-to-head comparison of CT and MRI first appeared in the literature in 2005. Among 17 patients (whose average age was 73), 6 received both MRI and CT for evaluation. Assuming an MRI gold standard, 4 of the 6 cases were misdiagnosed using CT; only 2 diagnoses were concordant among the 6 patients. One subcapital fracture on MRI was interpreted as a greater trochanteric fracture on CT. Three intertrochanteric fractures on MRI were misdiagnosed as greater trochanteric fractures on CT. This change in diagnosis led to a change in treatment; the trochanteric fractures were treated nonsurgically, and the intertrochanteric fractures required surgery. A second group in the study underwent MRI alone. The time to diagnosis between the 2 arms (MRI and CT versus MRI alone) varied, with the MRI and CT group at 80 hours, and the MRI-only group at 32 hours. The authors concluded that CT results were inaccurate in 66% of studies, and therapy was changed in 50% of cases based on the MRI results. Secondly, they suggested that an accurate and prompt diagnosis will aid in reducing cost, morbidity, and mortality. Note, however, that the study was limited by a small sample size.

In a more recent, larger study, 129 patients (whose average age was 65) received both CT and MRI for pelvic and proximal femoral insufficiency fractures. MRI demonstrated 99% sensitivity, when compared to 69% for CT, in detecting all pelvic and proximal femoral fractures when using a clinical reference standard augmented by follow-up imaging. With respect to proximal femoral fractures specifically, only 70% were detected by CT and 90% by MRI. Interestingly, radiographs visualized only 15% of fractures diagnosed on MRI and 21% on CT. A similar study evaluated CT and MRI head to head in detecting pelvic fractures in patients whose average age was 74 years. The study demonstrated fracture detection rates of 96% for MRI and 77% for CT when compared to a clinical reference standard.

Ultrasound

A single study, $n = 10$, using ultrasound (US) to detect radiographically occult proximal femoral fractures yielded 100% sensitivity and 65% specificity with an MRI reference standard. The authors conceded study limitations with respect to the number of cases as well as the potential availability of experienced musculoskeletal US-trained radiologists. Given only a single small study, there is not enough evidence to support the role of US in the workup of radiographically occult hip fracture.

Bone Scan

Prior to MRI, a bone scan was considered the test of choice for a radiographically occult fracture. Studies from 1979 and 1987 demonstrated 93% and 95% sensitivity, respectively. In 1998, a study demonstrated that MRI was more sensitive, specific, and cost effective relative to a bone scan. Two separate groups were scanned, 1 with nuclear bone scan and the second with MRI. The 2 groups were compared with respect to time to diagnosis, time to surgery, and cost. The bone-scan group averaged an additional day prior to surgery, thus incurring substantial additional costs. The authors concluded that MRI was a cost-effective alternative to a nuclear bone scan.

Although a bone scan has comparable high sensitivity relative to MRI, numerous limitations have been noted in the literature. False-positive scans are common, as any process that leads to increased bone turnover (arthritis, soft-tissue injury, and neoplasms) will demonstrate increased activity. Combining the high sensitivity of bone scintigraphy with the superior spatial resolution of multislice CT may prove useful in patients for whom MRI cannot be performed, but no comparative data are yet available.

The target patient population represents challenges for bone scanning. Cardiac and renal function are important in optimizing bone scintigraphy and are often compromised. Increased bone turnover related to osteoporosis may decrease the signal-to-noise ratio of the fracture and yield a false-negative scan. Additionally, bone scan availability may be limited in some centers.

Ultimately, bone scintigraphy is time consuming and has been demonstrated to lead to delayed treatment relative to MRI. The role of scintigraphy for detecting fractures may be an alternative for patients with contraindication for MRI. However, given mounting recent evidence, the bone scan's role as a second line of study may be usurped by CT in the future.

Bone Densitometry

The American College of Radiology and the Society of Skeletal Radiology (ACR–SSR) Practice Guideline for the Performance of Dual-Energy X-Ray Absorptiometry (DXA) states that DXA is indicated for all patients with a fragility fracture. Osteoporosis is defined as "A skeletal disorder characterized by compromised bone strength predisposing to an increased risk of fracture." By definition, a fragility fracture indicates a diagnosis of osteoporosis. The strategy behind obtaining a DXA in the post-fragility fracture patient is to establish a baseline for measuring the effectiveness of potential future therapy.

Summary

- The medical and socioeconomic impact of proximal femoral fractures is substantial. Expeditious diagnosis and treatment are critical for cost-effective care.

- Radiographs represent the best first test for evaluation.
- MRI is the most appropriate imaging choice for evaluating radiographically occult fracture in individuals >50 years old.
- CT and bone scintigraphy are second-line modalities, and US's role is unclear to date.
- Patients >50 years old with fractures from minimal or no trauma should undergo a DXA study for osteoporosis evaluation (American College of Radiology [ACR], 2008).

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e., <30 mL/min/1.73 m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73 m^2. For more information, see the ACR Manual on Contrast Media (see the "Availability of Companion Documents" field.)

Abbreviations

- AP, anteroposterior
- CT, computed tomography
- MRI, magnetic resonance imaging
- SPECT, single-photon emission computed tomography
- Tc, technetium
- US, ultrasound

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
	<0.1 mSv	<0.03 mSv
	0.1-1 mSv	0.03-0.3 mSv
	1-10 mSv	0.3-3 mSv
	10-30 mSv	3-10 mSv
	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies".		

Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

Scope

Disease/Condition(s)

Acute hip pain and suspected hip fracture

Guideline Category

Diagnosis

Evaluation

Clinical Specialty

Emergency Medicine

Family Practice

Geriatrics

Internal Medicine

Nuclear Medicine

Orthopedic Surgery

Radiology

Intended Users

Health Plans

Hospitals

Managed Care Organizations

Physicians

Utilization Management

Guideline Objective(s)

To evaluate the appropriateness of initial radiologic examinations for patients with acute hip pain and suspected hip fracture

Target Population

Patients with acute hip pain and suspected hip fracture

Interventions and Practices Considered

1. X-ray
   - Hip
   - Pelvis
2. Magnetic resonance imaging (MRI) pelvis and affected hip
   - Without contrast
   - Without and with contrast
3. Computed tomography (CT) pelvis and hips
   - Without contrast
   - With contrast
   - Without and with contrast
4. Ultrasound hip
5. Technetium (Tc)-99m bone scan hip

Major Outcomes Considered

- Mortality
- Sensitivity and specificity of radiologic examinations
- Cost-effectiveness
- Utility of radiologic examinations in differential diagnosis

Methodology

Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Staff will search in PubMed only for peer reviewed medical literature for routine searches. Any article or guideline may be used by the author in the narrative but those materials may have been identified outside of the routine literature search process.

The Medline literature search is based on keywords provided by the topic author. The two general classes of keywords are those related to the condition (e.g., ankle pain, fever) and those that describe the diagnostic or therapeutic intervention of interest (e.g., mammography, MRI).

The search terms and parameters are manipulated to produce the most relevant, current evidence to address the American College of Radiology Appropriateness Criteria (ACR AC) topic being reviewed or developed. Combining the clinical conditions and diagnostic modalities or therapeutic procedures narrows the search to be relevant to the topic. Exploding the term "diagnostic imaging" captures relevant results for diagnostic topics.

The following criteria/limits are used in the searches.

1. Articles that have abstracts available and are concerned with humans.
2. Restrict the search to the year prior to the last topic update or in some cases the author of the topic may specify which year range to use in the search. For new topics, the year range is restricted to the last 10 years unless the topic author provides other instructions.
3. May restrict the search to Adults only or Pediatrics only.
4. Articles consisting of only summaries or case reports are often excluded from final results.

The search strategy may be revised to improve the output as needed.

Number of Source Documents

The total number of source documents identified as the result of the literature search is not known.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Strength of Evidence Key

Category 1 - The conclusions of the study are valid and strongly supported by study design, analysis and results.

Category 2 - The conclusions of the study are likely valid, but study design does not permit certainty.

Category 3 - The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal.

Category 4 - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

The topic author drafts or revises the narrative text summarizing the evidence found in the literature. American College of Radiology (ACR) staff draft an evidence table based on the analysis of the selected literature. These tables rate the strength of the evidence (study quality) for each article included in the narrative text.

The expert panel reviews the narrative text, evidence table, and the supporting literature for each of the topic-variant combinations and assigns an appropriateness rating for each procedure listed in the table. Each individual panel member assigns a rating based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the ACR Appropriateness Criteria® Evidence Table Development document (see the "Availability of Companion Documents" field).

Methods Used to Formulate the Recommendations

Expert Consensus (Delphi)

Description of Methods Used to Formulate the Recommendations

Rating Appropriateness

The appropriateness ratings for each of the procedures included in the Appropriateness Criteria topics are determined using a modified Delphi methodology. A series of surveys are conducted to elicit each panelist's expert interpretation of the evidence, based on the available data, regarding the appropriateness of an imaging or therapeutic procedure for a specific clinical scenario. American College of Radiology (ACR) staff distribute surveys to the panelists along with the evidence table and narrative. Each panelist interprets the available evidence and rates each procedure. The surveys are completed by panelists without consulting other panelists. The appropriateness rating scale is an ordinal scale that uses integers from 1 to 9 grouped into three categories: 1, 2, or 3 are in the category "usually not appropriate"; 4, 5, or 6 are in the category "may be appropriate"; and 7, 8, or 9 are in the category "usually appropriate." Each panel member assigns one rating for each procedure for a clinical scenario. The ratings assigned by each panel member are presented in a table displaying the frequency distribution of the ratings without identifying which members provided any particular rating.

If consensus is reached, the median rating is assigned as the panel's final recommendation/rating. Consensus is defined as eighty percent (80%) agreement within a rating category. A maximum of three rounds may be conducted to reach consensus. Consensus among the panel members must be achieved to determine the final rating for each procedure.

If consensus is not reached, the panel is convened by conference call. The strengths and weaknesses of each imaging procedure that has not reached consensus are discussed and a final rating is proposed. If the panelists on the call agree, the rating is proposed as the panel's consensus. The document is circulated to all the panelists to make the final determination. If consensus cannot be reached on the call or when the document is circulated, "No consensus" appears in the rating column and the reasons for this decision are added to the comment sections.

This modified Delphi method enables each panelist to express individual interpretations of the evidence and his or her expert opinion without excessive influence from fellow panelists in a simple, standardized and economical process. A more detailed explanation of the complete process can be found in additional methodology documents found on the ACR Web site (see also the "Availability of Companion Documents" field).

Rating Scheme for the Strength of the Recommendations

Not applicable

Cost Analysis

- Several studies have examined the cost-effectiveness of magnetic resonance imaging (MRI) in occult fracture detection. One study demonstrated that delaying surgery only 1 day led to 1.27 times greater risk of death. A second study challenged the assertion that increased preoperative time was associated with increased mortality when corrected for comorbidities. However, there was an increased length of stay in the delayed group, again emphasizing the cost-effectiveness of an early and accurate diagnosis with respect to proximal femur fracture. A third study supported the finding that a delay in surgery in patients corrected for comorbidities led to increased mortality. A subsequent study confirmed the increased mortality and morbidity with delayed diagnoses. Finally, a meta-analysis has demonstrated that early surgery leads to decreased length of stay, morbidly, and mortality.
- A 1998 study measuring the cost-effectiveness of MRI against bone scintigraphy emphasized that the time to diagnosis using a bone scan was roughly 4 times greater than with MRI. The time to surgery in the bone scan group was 1 day greater than for the MRI group. More recently, a group in Denmark evaluated the cost-effectiveness of MRI and demonstrated high sensitivity, specificity, and accuracy with excellent agreement between radiology readers as well as a savings of approximately €250-650 ($325-845 US) related to prompt diagnosis. Another research group demonstrated the overall cost-effectiveness in allocating additional health-care resources for performing surgery <48 hours after patients were diagnosed with proximal femur fractures.
- Prior to MRI, a bone scan was considered the test of choice for a radiographically occult fracture. Studies from 1979 and 1987 demonstrated 93% and 95% sensitivity, respectively. In 1998, researchers demonstrated that MRI was more sensitive, specific, and cost effective relative to a bone scan. Two separate groups were scanned, one with nuclear bone scan and the second with MRI. The 2 groups were compared with respect to time to diagnosis, time to surgery, and cost. The bone-scan group averaged an additional day prior to surgery, thus incurring substantial additional costs. The authors concluded that MRI was a cost-effective alternative to a nuclear bone scan.

Method of Guideline Validation

Internal Peer Review

Description of Method of Guideline Validation

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

Evidence Supporting the Recommendations

References Supporting the Recommendations

American College of Radiology (ACR). ACRâ€“SSR practice guideline for the performance of dual-energy x-ray absorptiometry (DXA). Reston (VA): American College of Radiology (ACR); 2008.

Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current literature and expert panel consensus.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Potential Harms

False-positive and false-negative results of radiologic imaging

Gadolinium-based Contrast Agents

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e., <30 mL/min/1.73 m^2), and almost never in other patients. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73 m^2. For more information, please see the American College of Radiology (ACR) Manual on Contrast Media (see the "Availability of Companion Documents" field.)

Relative Radiation Level (RRL)

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document (see the "Availability of Companion Documents" field).

Qualifying Statements

Qualifying Statements

The American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report

Categories

IOM Care Need

Getting Better

Staying Healthy

IOM Domain

Effectiveness

Timeliness

Identifying Information and Availability

Bibliographic Source(s)

Ward RJ, Weissman BN, Kransdorf MJ, Adler R, Appel M, Bancroft LW, Bernard SA, Bruno MA, Fries IB, Morrison WB, Mosher TJ, Roberts CC, Scharf SC, Tuite MJ, Zoga AC, Expert Panel on Musculoskeletal Imaging. ACR Appropriateness CriteriaÂ® acute hip pain--suspected fracture. [online publication]. Reston (VA): American College of Radiology (ACR); 2013. 8 p. [48 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2013

Guideline Developer(s)

American College of Radiology - Medical Specialty Society

Source(s) of Funding

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Musculoskeletal Imaging

Composition of Group That Authored the Guideline

Panel Members: Robert J. Ward, MD, CCD (*Principal Author*); Barbara N. Weissman, MD (*Panel Chair*); Mark J. Kransdorf, MD (*Panel Vice-chair*); Ronald Adler, MD, PhD; Marc Appel, MD; Laura W. Bancroft, MD; Stephanie A. Bernard, MD; Michael A. Bruno, MD; Ian Blair Fries, MD; William B. Morrison, MD; Timothy J. Mosher, MD; Catherine C. Roberts, MD; Stephen C. Scharf, MD; Michael J. Tuite, MD;

Adam C. Zoga, MD

Financial Disclosures/Conflicts of Interest

Not stated

Guideline Status

This is the current release of the guideline.

Guideline Availability

Electronic copies: Available from the American College of Radiology (ACR) Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

Availability of Companion Documents

The following are available:

- ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.
- ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 2013 Apr. 1 p. Electronic copies: Available in PDF from the ACR Web site.
- ACR Appropriateness Criteria®. Evidence table development – diagnostic studies. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available in PDF from the ACR Web site.
- ACR Appropriateness Criteria®. Radiation dose assessment introduction. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available in PDF from the ACR Web site.
- ACR Appropriateness Criteria®. Manual on contrast media. Reston (VA): American College of Radiology; 90 p. Electronic copies: Available in PDF from the ACR Web site.
- ACR Appropriateness Criteria®. Procedure information. Reston (VA): American College of Radiology; 2013 Apr. 1 p. Electronic copies: Available in PDF from the ACR Web site.
- ACR Appropriateness Criteria® acute hip pain—suspected fracture. Evidence table. Reston (VA): American College of Radiology; 2013. 21 p. Electronic copies: Available in PDF from the ACR Web site.

Patient Resources

None available

NGC Status

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